DISPLAY PARTICULARLY CONFIGURED FOR VISUALIZING TRENDS IN DATA

TECHNICAL FIELD

[0001] The present invention is in the field of visual metaphors for tracking trends in data sets and, in particular, relates to displays that, while presenting a view of a particular domain, also highlight particular trends in the data sets as an aid to decision making based on the data.

BACKGROUND

[0002] Particularly during the internet boom, venture capital (VC) investments have yielded uncharacteristically high returns. As a result, start-up companies have found it relatively easy to attract VC investment. More recently, however, the volatile state of the capital markets has dictated that investors give investments greater scrutiny. That is, it has become important for each VC to monitor the state of the market and continually update its investment strategy to suit the rapidly changing market conditions.

[0003] A common problem faced by many venture capitalists is information overload. Venture capitalists are inundated with business plans from aspiring startups. Thus, it is desirable to filter out some of the business plans so that the remaining business plans are for startups that are most likely to yield significant returns on investment.

[0004] It is desirable to have tools to assist venture capitalists to make informed investment decisions and, in particular, to monitor investment flows and performance of startups and, other VC firms, over time. More generally, in other domains, it is desirable to have tools to assist in making informed decisions with respect to trends in data relating to those domains.

SUMMARY

[0005] In accordance with one aspect of the invention, a method is provided to generate a display corresponding to a plurality of objects, on a display device. A plurality of portions of the display device are allocated to correspond to a plurality of separate domains into which the objects are categorized. With each portion, a shape is displayed for objects in the corresponding domain. The shapes are arranged in a spiral. The spatial relationship among the shapes in the spiral is determined based on a particular value of a characteristic associated with the objects.

[0006] In accordance with a further aspect of the invention, a method is provided to generate a display, on a display device, representing at least one object. A plurality of portions of the display are allocated to correspond to a plurality of separate ranges of values of a first characteristic (such as time segments). At each of the plurality of portions, an indication is displayed of a value of a second characteristic of the at least one object in the range of the first characteristic to which that portion corresponds.

[0007] In accordance with a further aspect of the invention, a method is provided to generate a display, on a display device, representing objects. A plurality of first shapes are generated on the display. Each first shape indicates a number of objects having a value of a first particular characteristic that is within a range of values corresponding to that first shape. Within each first shape, a second shape is generated for at least some of the objects associated with that first shape. Each second shape indicates a value of a second particular characteristic of that object.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 illustrates a hierarchical graphical display in which the lowest hierarchy is displayed in a spiral arrangement.

[0009] Figure 1-1 illustrates a process to generate the Figure 1 display.

[0010] Figure 2 schematically illustrates the organization of a particular spiral arrangement in the Figure 1 display.

[0011] Figure 3 illustrates how a particular spiral arrangement of the Figure 1 display changes over time.

[0012] Figure 4 illustrates an alternate embodiment of the Figure 1 display.

[0013] Figure 5, which does not illustrate the invention, graphically illustrates a comparison of the performance of the top thirty largest VC firms in terms of total money invested.

[0014] Figure 6 illustrates a compact representation of the performance of a single VC firm, including multiple timelines in a single representation.

[0015] Figure 6-1 illustrates a process to generate the Figure 6 display.

[0016] Figure 7 illustrates a conglomeration of Figure 6 display, for multiple VC firms.

[0017] Figure 8 illustrates a variant of a conventional histogram display, in accordance with an embodiment of the invention, in which VC firms are associated with bars according to total investment and in which each bar includes an indication, for each VC firm associated with that bar, of the percentage of least successful startup companies within the portfolio of that VC firm.

[0018] Figure 8-1 illustrates a process to generate the display of Figure 8.

[0019] Figure 9 illustrates a computer system on which the processes of Figures 1-1, 6-1 and 8-1 may be implemented.

DETAILED DESCRIPTION

[0020] In accordance with various aspects of the invention, three methods and systems for displaying trends in venture capital (VC) investment data are described. Thereafter, it is discussed how the described methods and systems have application to displaying trends in data other than VC investment data.

[0021] As discussed in the Background, one important task for venture capitalists is to monitor investment flows within the startup company's market. This gives VC firms a view of what competitor VC firms are doing, which industries are flourishing, which industries are reaching saturation, and whether there is any advantage to being first within a particular area (first mover advantage). Throughout this description, various example displays are shown. It should be noted that these example displays do not necessarily resemble displays that would be generated based on actual data.

[0022] Figure 1 illustrates a display (SpiralMap™ display) to assist the venture capitalist with this task. The display process (illustrated in Figure 1-1) to generate the Figure 1 display utilizes the three-level hierarchy of industry groups by which VentureOne (a VC information company headquartered in San Francisco, California) categorizes VC portfolio companies. Turning now to Figures 1 and 1-1, at step 152 (Figure 1-1), a portion of the display is allocated to each topmost level industry group. For example, in the Figure 1-1 display, each such industry group is represented by an oval, an example of which is denominated by reference numeral 104 and is provided with an associated label 106 "Software ($9998.1 M)". Each label 106 is indicative (for example, by color) of the industry group into which the corresponding industry can be categorized. For example, labels for industries in the information technology area (e.g., information services, software and communications) may be colored yellow, labels for industries in the healthcare area may be colored green, labels for industries in the retail area may be colored purple, and labels for other miscellaneous industries may be colored blue.

[0023] Furthermore, the color of each oval 104 indicates the total investment in the industry represented by the oval. (The figures of the patent application are black and white, and the shades roughly map to actual colors.) The size of each oval 104 roughly approximates the number of sub-industries and VC portfolio companies within the particular industry represented by that oval 104. The color of an oval 104 may be employed to encode any aggregate attribute of the industry represented by the oval, such as average investment per startup company or total investment for all startup companies in the industry.

[0024] Referring again to the Figure 1-1 flowchart, at step 154, a square sub-portion of each oval is allocated to each sub-industry of the industry represented by the oval. The background color of each square sub-portion indicates the total investment within the sub-industry. For example, two relatively bright squares within the communications industry oval 108 are allocated to the connectivity products sub-industry 110 and to the telecommunications service providers sub-industry 112. The size of a particular square, on the other hand, is an indication of the number of startup companies within the sub-industry to which the square is allocated. Furthermore, the location of each square within an oval with respect to each other square within the oval is an indication of the "closeness" of the sub-industry represented by that square with respect to each other square.

[0025] At step 156 of the Figure 1-1 flowchart, shapes are displayed within the square allocated to a particular sub-industry for each startup company within that sub-industry. In particular, as illustrated with reference to Figures 2 and 3, multiple shapes (each referred to herein as a "company square") are displayed within the sub-industry square, arranged in a spiral 200. The color of each company square indicates the total VC investment for the company represented by that square. For example, the brightest colors may indicate higher total investment while the darkest colors indicate lower total investment. The squares are arranged within the spiral 200 such that squares at the center of the spiral 200 represent the oldest companies (as

determined by the date of the company's seed or first round investment), progressing to the outside 204 of the spiral where shapes representing the newest companies are located.

[0026] Referring specifically to Figure 3, the squares 302, 304, 306 and 308 indicate a time progression of VC investment within a sub-industry. While the Figure 3 display utilizes time, the display may be based on the progression of any characteristic. It can be seen from the color of the company squares in the spirals within the squares 302, 304, 306 and 308 that the younger companies (at the outside of the spiral) are generally more heavily financed (i.e., have larger VC investment) than the older companies (at the center of the spiral). This indication of time progression allows one to see whether companies that penetrated a particular sub-industry earlier (i.e., are located towards the center of the spiral) have an advantage over latecomers (located towards the outside of the spiral), or vice versa.

[0027] In accordance with other embodiments, each oval (representing an industry) and/or square (representing a sub-industry) is indicative of any aggregate attribute of the startup companies within that industry or sub-industry. For example, an oval or square may be displayed with a color that is indicative of an average investment for the startup companies within the industry or sub-industry, respectively.

[0028] Referring back to Figure 1, in accordance with embodiments of the system, a time slider 114 is provided. As indicated by arrow 158 in Figure 1-1, the time slider 114 may be operated to modify the time frame (e.g., from 1994 to 2000) of the data used to generate the display 100. In particular, when the time frame of the display 100 is modified, step 156 is performed to process the data of the new time frame. By manipulating the time slider 114, a user can see how the investment flows are changing through time (i.e., which industries are becoming "hot" and which are becoming "cold"), and how different industries and sub-industries are growing. For example, fast and rapid growth combined with relative low initial investments is an

indicator of low barrier to entry, while a slowdown in growth in an indicator that an industry is reaching its saturation point. Referring again to Figure 3, it can be seen that for the illustrated sub-industry, younger companies (the squares at the tail of the spiral) actually ended up being more heavily financed than the older companies, as indicated by the relative colors of the squares.

[0029] Thus far, the description with respect to the company squares has been such that each square representing a particular startup company is indicated with a color based on the total investment amount for that company. In accordance with some embodiments, each company square is displayed with a color that indicates an amount of total investment in the company represented by the square relative to other companies in the same sub-industry. For example, in accordance with one such embodiment, the square for the startup company with the highest total investment out of all startup companies in the sub-industry is displayed with a color that indicates "maximum", and the square for the startup company with the lowest total investment is displayed with a color that indicates "minimum". In accordance with another such embodiment, each company square is displayed with a color that indicates the total amount of investment in that company relative to other companies in the entire industry to which the company represented by the company square belongs, or even relative to all companies in all industries.

[0030] Figure 4 illustrates a variation on the Figure 1 display. In accordance with the Figure 4 embodiment, each sub-industry square and company square is displayed with a color that facilitates the process of mining for white space. White space is a term used by VC's for industries or sub-industries that are successful (by some measure), but in which relatively few investments have been made. In other words, these are industries or sub-industries that were unanticipated by the investment community at large to be successful. In theory, at least, these areas yield the highest return on investment because they are highly profitable, and yet the profits are distributed among a smaller number of investors.

[0031] Figure 4 illustrates a display visualization of the same data upon which the Figure 1 display is based. In Figure 4, each sub-industry square is displayed with a background color indicating the average investment among companies in that sub-industry. Furthermore, each company square is displayed with a color representing the market capitalization of that company at initial public offering, relative to all other companies regardless of sub-industry. For example, in the Figure 4 embodiment, company squares displayed brightest are within the top 20% of all startup companies in terms of market capitalization at initial public offering. Market capitalization is utilized as a simple indication of company success. Thus, the sub-industry squares with a lot of bright company squares are the sub-industries with many successful companies. White space, therefore, indicates each sub-industry with relatively low average investment as indicated by the background color of the square representing that sub-industry with a lot of bright company squares. Some examples of such white space in Figure 4 include the connectivity products 402, software development tools 404, business software 406, consultants 408, and online content 410 sub-industries. Other sub-industries may have high startup company success rates (many bright company squares), but also have relatively high average investment numbers. As a result, it can be inferred that such sub-industries are less profitable.

[0032] The displays described above with respect to Figures 1, 1-1, 2, 3 and 4 display financial data in a hierarchical manner. The SmartMoney map (see http://www.smartmoney.com/marketmap), derived from TreeMaps (see, for example, Shneiderman, Tree visualization with tree-maps: 2-d space-filling approach, ACM Transactions on Graphics, 11(1):92--99, 1992 also displays financial data in a hierarchical manner. However, in contrast to the SmartMoney map the display in accordance with some embodiments facilitates evaluation of VC investments. For example, the display in accordance with some embodiments provides an indication of first mover advantage. Furthermore, the position of an indication relating to a particular company may be fixed over time in the display, which allows easier

determination from the display of trends through time -- on a company, sub-industry and industry level. In the SmartMoney map, each company is tied to a square and the square sizes and positions are tied to encoded data. Thus the size and position of the squares change from one time slice to another based on changes in the encoded data.

[0033] In accordance with some embodiments of the display such as those shown in Figures 1 and 4, aggregate figures at a sub-industry and industry level are indicated. That is, the display indicates detailed information about each company simultaneously with aggregated figures for the sub-industry and industry to which the company belongs. The SmartMoney map only provides information about individual companies. While aggregate results may be visually approximated from the gestalt view of the individual companies, these aggregate results are not indicated explicitly.

[0034] In accordance with embodiments of the invention, the size of a sub-industry square indicates the number of startup companies in that sub-industry. This shows a level of saturation of the sub-industry, as well as indicating the rate of growth (when used together with the time slider 114). By contrast, the SmartMoney map does not provide an indication of saturation level, it is difficult to see how crowded an industry is because each company square has a different size.

[0035] Now, a "TimeTicker™" display embodiment is discussed as a tool for examining VC investments. The display is discussed with reference to Figure 5 (which are not illustrative of the invention but, rather, help to explain the invention) and Figures 6, 6-1 and 7. In addition to monitoring the investment flows with respect to startup companies and industries, it is also desirable to examine the performance of particular VC firms. For example, this can help enable one to identify broader investment strategies that are effective on a group or portfolio level. As another example application, this display embodiment can be used to track characteristics of individual stocks.

[0036] Timelines can be used to track the performance of various VC firms over time. For example, Figure 5 illustrates a comparison of the performance of thirty

large VC firms (in terms of total money invested). One problem with using timelines in the manner of Figure 5 is that there is too much occlusion, which makes it difficult to compare among the performance of the different VC firms. All the information that can be derived from Figure 5 is that the VC-A does very well towards the end of the time period while VC-B performs well during the middle period. Timelines are useful when comparing a small number of objects, but overcrowding makes it difficult to interpret timelines that include more than about ten objects.

[0037] Now, the TimeTicker™ representation embodiment is described with reference to Figures 6, 6-1 and 7. Figure 6 shows a graphical representation of investment results, over time for a single VC firm. As can be seen from Figures 6 and 7, this representation is compact and allows for comparison of results for many VC firms simultaneously. In Figure 7, a separate line is displayed for each VC firm. Each line is divided into multiple segments 902 (902a through 902g in the specific display of Figure 6), each segment corresponding to a separate time period. The display for each segment 902 includes a rectangle whose length corresponds to the performance of the VC firm for that particular time segment 902. For example, for the VC firm represented in Figure 6, the VC firm performed well in the time periods represented by segments 902a and 902b. Then, the performance dropped (segments 902c and 902d). In the time period , corresponding to segments 902e through 902h towards the end of the time period represented by the Figure 6 display, the performance of the VC firm improved. In addition to using the length of the rectangle to represent performance, the performance information may be encoded in the color or shade of the rectangle, as shown in Figure 7.

[0038] Figure 6-1 is a flowchart representing a process to generate the Figure 6 display. At step 952, portions of the display are allocated to correspond to separate time segments. At step 954, at each allocated portion, an indication is displayed of a characteristic of a particular VC firm for the time segment corresponding to that

allocated portion. For example, the characteristic may be return on investment as described above with reference to Figures 5.

[0039] Figure 7 illustrates a display similar to the Figure 6 display, but in which data representing multiple VC firms are displayed. Specifically, Figure 7 displays data of the thirty VC firms for which data is shown in Figure 5. Using the Figure 7 representation, the performance of each VC firm can be more easily evaluated than with the Figure 5 representation. For example, by the length of the rectangles on the lines for these VC firms, it can still be clearly seen that VC-A performs well towards the end time period and VC-B performs well during the middle time periods. In addition, it can also be seen that VC-C performed well in the initial time periods, VC-D performed well in the middle time periods, and VC-E has consistent performance throughout the time periods.

[0040] Now, with reference to Figures 8, 8-1 and 9 a Double Histogram™ (or histogram^{2TM})embodiment in accordance with the invention is described. This display is useful for examining the correspondence between the size (or other first characteristic of a VC firm) and the success of its investments (or other second characteristic of the VC firm).

[0041] Referring to Figure 8, a variant of a conventional histogram display is illustrated. The x-axis 1152 represents size of a VC firm as measured by the VC firm's total investment in startup companies. The height of each bar 1102a through 1102i (generically, 1102) indicates the number of VC firms in the sample for which the total investment of each such firm falls into a given range. So far, this is similar to a conventional histogram. However, each bar 1102 also includes a sub-histogram. Specifically, each rectangle 1104 (which in Figure 8 is a rectangle having negligible width -- a line) within a particular bar represents one VC firm. The length of each rectangle 1104 indicates the percentage of non-successful (by some measure) of startup companies with the portfolio of that VC firm. This VC firm rectangle may be displayed with a color that indicates the percentage of startup companies that fall into

a particular range of success. For example, Figure 8 is based on data for startup companies with low market capitalization on their IPO date (i.e. the less successful startups). The secondary rectangles (each corresponding to a separate VC firm) are then colored based on the number of startups within the portfolio of that VC firm that are also in the selected set. From Figure 8, where brighter rectangles indicate a larger number of startup companies within the selected set, it can be seen that the least successful startups form the largest part of the small VC firms' portfolios. That is, there are many bright rectangles in the bar designated by reference numeral 1102.

[0042] It can be seen, then, that the type of display illustrated in Figure 8 can be especially useful for finding relationships between the characteristics of objects (e.g., startup companies) and an associated container object (e.g., a VC firm that has invested in the startup companies). Thus, using the type of display illustrated in Figure 8, the relationship between the total investment of VC firms and the market capitalization of the startup companies in which they invest can be seen. This is an advancement over the conventional scatter plot, because the scatter plot has high potential to occlude the data. This is particularly so when there are many data points that evidence a particular relationship, since these data points tend to be displayed in close proximity to each other on the scatter plot.

[0043] Figure 8-1 is a flowchart illustrating a process to generate the displays of Figure 8. At step 1182, a "bar" portion of the display is allocated to each category of VC firm size. At step 1184, within each bar portion, a portion of the bar is allocated to a particular VC firm within the category represented by the bar. At step 1186, for each VC firm, the display indicates a particular characteristic of the VC firm at the portion of the bar allocated to the VC firm.

[0044] Figure 9 illustrates one example of a computer system 1300 on which the present invention may be implemented. The box labeled 102 includes a CPU and other processing electronics. The CPU executes a program to process data in order to generate a display on display device 1304. The data may be held, for example, on

storage device 1306. User input is provided via a keyboard 1308 and mouse 1310. A printer 1312 is provided, and may be used as a medium for generating the display.

[0045] Thus, in accordance with the various invention, VC investment data is more easily analyzed and useful information realized. The claims appended hereto are not intended to be limited to the specific embodiments disclosed herein. For example, the methods described also have applicability to domains of data other than VC investment data.